VOLUME 4, NO. 1

ENVIRONMENTAL QUARTERLY

Acoustic Punishment of Airborne Components

•

Organizational Aspects of the Environmental Problem

•

IEE Announces Brilliant Program For Second Annual Meeting

•

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FIRST QUARTER 1958

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Vol. 4, No. 1 First Quarter 1958

ENVIRONMENTAL QUARTERLY

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Acoustic Environment 4
by R. Kaminski, Bell Aircraft Corp.
Intense noise can cause electronic and structural failure. The author reports on investigations of the exposure of airborne components to simulated noise.

2nd Annual IEE Meeting Programmed 6
Brilliant rosted of experts assembled to present information of extreme timeliness before this expanding society.

Organizational Aspects of the Envirnomental Problem 9
by Ray M. Daniel, Northrop Aircraft, Inc.
The author warns of national delay and frustration if problems in this area are not solved—and soon.

Random and Complex-Wave Vibration Test Systems 11
by Uno Hedin, Ling Electronics, Inc.
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Barry Controls offers constructive comment on last issue's "Shock Testing" article.

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MANUFACTURING MEMBERS OF THE EEI: Alpha Electric Refrigeration Co., Detroit, Mich.; American Research Corp., Farmington, Conn.; Bemco, Inc., North Hollywood, Cal.; Cincinnati Sub-Zero Products, Cincinnati, Ohio; Harris Refrigeration, Cambridge, Mass.; Hudson Bay Co., Chicago, Ill.; International Radiant Corp., Port Washington, N. Y.; Murphy & Miller, Inc., Chicago, Ill.; Standard Cabinet Co., Carlstadt, N. J.; and Tenney Engineering, Inc., Union, N. J.

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The **Environmental Quarterly** is circulated to men concerned with environmental simulation and testing in industry, Government and our universities. It is the only magazine devoted exclusively to environmental science, simulation, and testing. Published four times a year by the Environmental Equipment Institute and the Institute of Environmental Engineers, DR. GEORGE D. WILKINSON, General Manager. U. S. and Canada, $4.00 per year. Other countries, $5.00 per year. $1.00 per single copy, when available. Executive, editorial, and advertising offices: 9 Spring St., Princeton, N. J. WAlnut 1-6850. Please include return postage with unsolicited manuscripts. All manuscripts must be double-spaced. The editor invites queries regarding proposed articles. Statements and opinions appearing in the **Environmental Quarterly** are individual expressions and are not necessarily those of the staff of the Quarterly nor of the EEI or the IEE. Copyright © 1958, the Environmental Equipment Institute, Inc., and the Institute of Environmental Engineers, Inc. Printed by Princeton Printing Co.,Princeton, N. J.

The General Manager Speaks . . .

LOCAL CHAPTER MEMBERSHIP CONTEST

The Institute of Environmental Engineers must grow. We have everything a full-fledged engineering society should have except a full quota of members. Many engineers intend to join, but haven't taken the final step. Some don't know how, and, strange as it may seem, some don't even know they can. Local chapters are the focal points in the drive to get more membership, because they provide meeting places where engineers can get acquainted. Because of the key position our local chapters have in building membership, the Executive Committee has decided to give the chapters a chance to win recognition for their efforts.

During 1958, each chapter will have a new membership quota. At the end of each quarter, the chapter bringing in the greatest number of new members, expressed as a percentage of the chapter quota, will be declared Membership Champions for that quarter. As a token of achievement, the chapter will receive a banner which it can display above the speaker's rostrum at chapter meetings. It will keep the banner for the next quarter, or until another chapter wins it away. In the unlikely event that one chapter wins the award for four successive quarters, the chapter's name and year will be added to the banner, and it will become permanent chapter property.

The spark plugs will be the chapter Membership Chairmen. Here are their names and quotas.

Bob Rudkin, New York Chapter, 4 new members monthly

W. J. Carey, Chicago Chapter, 4 new members monthly

A. B. Billet, Detroit Chapter, 1 new member monthly

So that we can publish the results promptly in the *Quarterly*, the first quarter will be considered to have started on December 1, 1957, and to end February 28, 1958. Succeeding quarters will follow the same pattern.

In our next issue, look for the name of the first winning chapter and the picture of the winning Membership Chairman.

GEORGE D. WILKINSON
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IEE LOCAL CHAPTER NEWS

Detroit Chapter Chartered

DETROIT—Third chapter to be fully accredited by the Executive Committee of the IEE is that of Detroit. Officers of the new group are:

President—A. B. Billet, Vickers Incorporated
Vice Pres. and National Director—R. G. Yaeger, Chrysler Corporation
Secretary—J. Reichart, Alpha Electric Refrigeration Co.
Treasurer—E. Fleck, Excello Corporation

At its best attended meeting, IEE members and guests heard a talk by Maj. Geo. A. Tuttle, chief of the Labs Div., Detroit Arsenal, on the environmental testing of military vehicles. Maj. Tuttle also guided the group on a tour of the Arsenal's vehicular environmental test lab.

PHILADELPHIA, BALTIMORE, WASHINGTON—On December 17, the proposed Mid-Atlantic Chapter submitted its application for charter to the Executive Committee of the IEE. This group held a business and technical meeting Oct. 31 at The Martin Company plant in Baltimore during which it selected officers, toured the Martin environmental lab, and heard the following papers: "Noise Level Predictions from Jet Engine Wake," Edward J. Kirchman, The Martin Co.; "Dynamic Flight Environment of Controlled Rockets," Donald Edeland, The Martin Co. The tentative governing body selected, pending approval of charter by the IEE Executive Committee, includes:

Chairman—David Askin, Frankford Arsenal
Vice Chairman—Henry Stein, American Electronics
Secretary—Martin Schletter, Tenney Engineering, Inc.
Treasurer—Stuart G. Hibbins, Westinghouse Air Arm Div.
Directors—H. C. Jones, Westinghouse Air Arm. Div. Frederick M. Reitz, Emerson Research Lab, Theodore F. Foti, The Martin Company, and Peter J. Zukauskas. The Martin Company.

BOSTON—The proposed Boston Area Chapter held its second highly successful meeting at the Environmental Lab of AVCO Research & Adv. Development Div. in Lawrence, Mass., Oct. 15. Attendance was over 125. The group toured the AVCO Lab and heard Charles Cohen of AVCO discuss testing under combined environmental conditions. Slides were presented showing design and performance aspects of the facility—basically a 6-foot diameter centrifuge, the shaft of which is driven by a large vibration exciter. The centrifuge field in insulated and conditioning equipment provides a wide range of temperature control.

The Boston group held its third meeting Dec. 11 at the Hotel Lenox in Boston, and, according to Temporary Chairman Robert J. Graeff, of Equipment Sales Co., Inc., was less well attended than earlier meetings because of supremely miserable weather and Christmas parties. At any rate, Graeff said, the technical side of the meeting was outstanding. "Endurance—A Reliability Concept," was presented by Albert R. Richardson, Exec. Officer, MIT Aeroelastic & Structures Research Lab. This paper dealt with a statistical approach to obtaining reliability data on components. Using relays subjected to vibration environments as an illustration. Richardson outlined a method of obtaining survival probability for a given relay subjected to a specified vibration level of a definite time interval.

NEW YORK—The New York Metropolitan Chapter held its Fall meeting Oct. 24 at the Governor Clinton Hotel and heard Dean Arlidge, Consolidated Electrodynamics Corp., discuss shock testing. Arlidge covered a definition of shock, acceleration-shock waveforms, shock simulation methods, and instrumentation for readout. The meeting also viewed the new Air Force film, "Design for Environment."

(Continued on Page 17)

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Airborne Components in an Intense

ACOUSTIC ENVIRONMENT

R. KAMINSKI, Bell Aircraft Corporation

Intense noise can cause electronic and structural failure. Here is a report of investigations carried out in the Research Div. Labs of Bell Aircraft by Dr. W. Fricke, Mr. S. Kuzara, and the author.

High-intensity acoustic fields of approximately 140 to 160 db (Reference 0.0002 microbar) cause electronic and structural failures that resemble those produced by vibration. A growing recognition of this fact attracted a large audience to the acoustic environment session at the First Technical Meeting of the Institute of Environmental Engineers (1). References (2) and (3) are representative articles available to engineers interested in the art of acoustic testing. Although the literature on the subject continues to grow, it is still extremely limited.

This article describes the acoustic test chambers and evaluations conducted at Bell Aircraft Corporation. Equipment that produces high-intensity sound was developed for the evaluation of small airborne components.

The Bell Aircraft acoustic program began with an investigation of test systems. Sound fields are basically reverberant, progressive, or resonant, and different chambers must be constructed for each field.

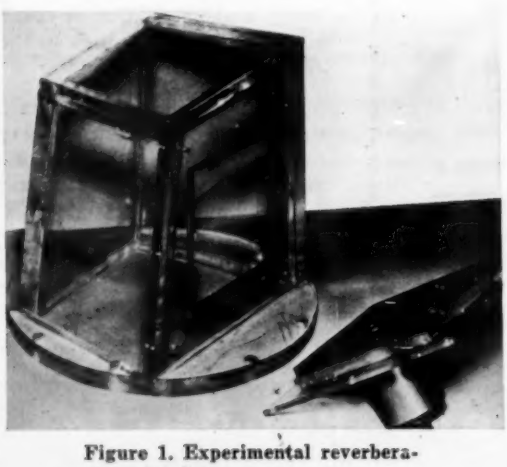

Figure 1. Experimental reverberation chamber.

Most progressive wave and reverberation methods require high-power, complex equipment. Bird (4) reported the use of a fixed-volume acoustic chamber for the investigation of electron tube microphonics. At Bell Aircraft, an experimental plexiglas reverberation chamber (Fig. 1) produced an overall random noise level of 150 db for tests on sub-miniature electron tubes. Octave band analysis showed that the acoustic levels within the plexiglas chamber were similar to the data for rocket engines.

Our attention centered on the resonance technique because by means of this high-intensity sound can be produced using simple, low-power equipment. In addition, resonant chambers are suitably sized for the smaller airborne components. Two forms of Bell resonant chambers (Fig. 2) are based on the principle of wave reinforcement in the resonant system (5). A maximum sound level of 168 db was produced in the rectangular chamber by an air-cooled loudspeaker.

A recent report describes some of the acoustic chambers now in use (6). The solutions to the problem of high-intensity sound generation differ considerably:

Convair-Pomona: A plane-wave tube

Rototest Laboratory: An inverse exponential horn

Altec-Lansing: An unsymmetrical chamber (reverberation)

Northrup: A 130 db interim chamber and pulse-jet installation

Douglas: A siren system

Bell: Rectangular and tubular resonant chambers

Electron Tube and Hardware Investigation

The 5814A miniature twin-triode tube was the first

component tested at discrete frequencies in the tubular chamber (7). From a 20-tube sample, the 100mVac output of one tube equaled the maximum defined in MIL specifications (8). A 140 db sound pressure level at 1,000 cps produced the failure.

Twenty 5841WA tubes passed their acoustic evaluation tests. The mean and peak mVac microphonic outputs of the 5841WA tubes were one-fourth of the respective 5814A outputs. The empirical mode of the 5814WA peak outputs occurred at 2,400 cps; eighteen of the twenty 5814A tubes peaked at 1,000-1,400 cps. The microphonic spectrum of the 5814WA tube changed when different type mountings were used, but the spectrum reductions were not significant when the data was compared with outputs of JAN socket-mounted tubes.

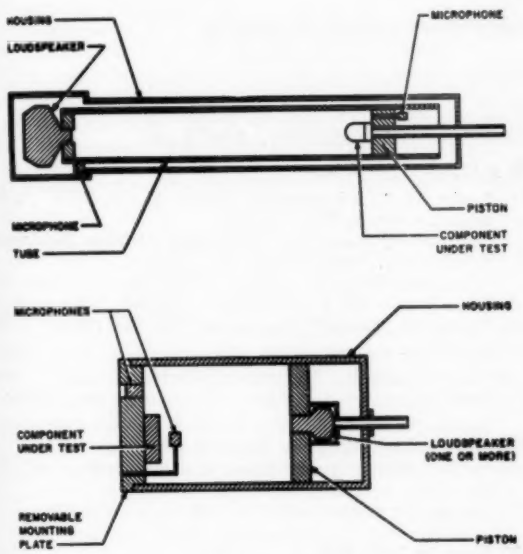

Figure 2. Tubular and rectangular resonant chambers.

High-intensity sound tests on 6021 sub-miniature twin-triodes produced microphonics above the MIL-E-1 limit (9) of 50 mVac. The lowest 6021 outputs (without failure) occurred during Metex resilient cooling-sleeve tests. A solid metal block held the sleeve, and the sleeve held the tube. The mounting pointed to a design that was both a good acoustic shield and an excellent heat sink.

Relay Investigations

Investigation of twenty sensitive relays showed the contact chatter bands (Fig. 3) at sound pressure levels of 145-160 db and discrete frequencies of 350-3,500 cps. Contact resistance changes preceded chatter. For example, one relay had a peak contact resistance of 0.58 ohms at 145 db and 1425 cps and chattered when the sound level was increased to 150 db.

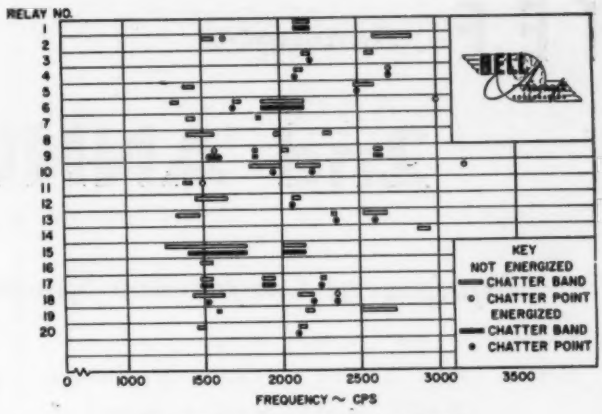

Figure 3. Contact Chatter of relays in a high-intensity acoustic environment.

An oscilloscope showed the contact resistance changes and chatter. Observations verified the contact behavior reported by Jacobson (10). The resistance changes of the contacts were usually in phase with the acoustic frequency, and the changes resulted in a large variety of wave forms.

Barometric Switch Investigation

The rectangular resonance chamber provided a facility for evaluation of four-element capsule-type barometric switches. Sound waves chattered the switch (Fig. 4) and shifted the static (no sound) actuation points. The displacements of successive static actuation points show the calibration shifts. Each of the four elements exhibited a different sensitivity to acoustic excitation.

Other Acoustic Investigations

Recent tests on crystal accelerometers and their amplifiers showed that these units can be affected by high-

(Continued on Page 16)

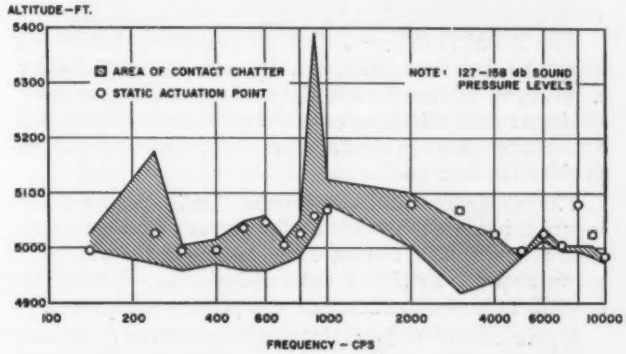

Figure 4. Contact chamber of a barometric switch element in a high-intensity acoustic environment.

IEE *Announces*

2nd ANNUAL MEETING

Equipment Conference Sponsored by EEI

Kurt R. Stehling, Vanguard Missile Project, to Talk of Environment in Satellite and Space Vehicle Programs

A display of the earth satellite model and a luncheon address by Kurt R. Stehling, Propulsion Head of the Vanguard Missile Project, Naval Research Laboratory, will highlight the Second Annual Technical Meeting of the Institute of Environmental Engineers April 17 and 18, 1958, at the New Yorker Hotel, New York City, according to Henry F. Sander, President of the IEE, and Director of Standard and Quality Controls, Vapor Heating Corporation.

Over fifty engineers, scientists, and administrators will participate in this presentation of the largest volume of vital know-how in the field of environmental science, simulation, and testing ever undertaken, according to Arthur Billet, Program Chairman for the meeting, and Vice-president of the IEE. Billet is Senior Staff Engineer, Aero Hydraulics Div., Vickers Incorporated.

Representatives of the Secretary of Defense, Army, Navy, and Air Force will present a panel discussion and seminar on "Basic Planning For Environmental Testing" during the second day's session H (see program).

Rear Admiral George Dufek, Commander, U. S. Naval Support Force, Antarctica, or a representative will deliver a luncheon address before the anticipated 600 or more engineers and scientists on Operation Deep Freeze III and related environmental and other low-temperature problems, Billet said.

The Environmental Equipment Institute, a related organization, will sponsor an Equipment Conference so that attendee can discuss their testing problems with manufacturers. Exhibit booths will also be occupied by manufacturers of auxiliary or component equipment.

A press room will be maintained for the use of editors and reporters, according to Norman Meyers, Publicity Chairman. Meyers is a member of the Engineering staff at Stratos Div., Fairchild Engine and Airplane Corp.

Following is the preliminary program:

THURSDAY, APRIL 17

9:00 A.M. to 11:30 A.M.

Session A: "Environmental Testing of the B-58," A. Kunmickey, Convair, Forth Worth
"Air Cooling Simulation for Testing Airborne Equipment," B. Friedman, Tenney Engineering, Inc.
"Air Conditioning of Cabin and Equipment in High Speed Aircraft and Its Environmental Problems," J. Makowski, Stratos Div., Fairchild Engine and Airplane Corp.

Session B: West Coast vibration paper, to be announced.
"Jig and Fixture Design for Vibration Tests of Missile Components," John F. Clarke, The Martin Co., Denver

Session C: 'Sand and Dust Tests of Aircraft Components," James Pauley, Southwest Research Institute
"A New Ozone Testing Chamber & Instrumentation," Mark Sigismund, Frankford Arsenal
"Design for Environment," an Air Force color film

12:00 Noon to 1:45 P.M.

Luncheon. Speaker: Rear Admiral George Dufek, "Operation Deepfreeze III"

2:00 P.M. to 3:30 P.M.

Session D:"Simulated Re-entry of Guided Missile Structures," P. T. Stanaitis, Missile Operations, Chrysler Corporation
"Design of a Simulated Flight Test Chamber for Missile Equipment," Arthur Woods, Arma Div., American Bosch Arma Corp.

Session E: "Non-destructive Testing in the Atomic Energy Field," Gerold H. Tenney, Los Alamos Scientific Laboratory
"Radiation Effects Information Center," Carl J. Lyons, Battelle Memorial Institute.

Session F: "Correlation of Structural Fatigue Relative to Discrete Frequency, Constant Amplitude, and Random Acoustic Excitation," Gordon Getline, Convair, San Diego
"Component Acoustic Testing; Plane Wave Tube and Reverberant Chamber Methods," Charles W. Remaley, Sandia Corporation

3:30 P.M.

Environmental Equipment Conference, under the auspices of the Environmental Equipment Institute

4:30 P.M. to 6:30 P.M.
Cocktail Hour—Compliments of the Environmental Equipment Institute

FRIDAY, APRIL 18

9:00 A.M. to 11:30 A.M.
Session G: "Combined Effect of Mechanical and Radiation Stress," T. C. Helvey, The Martin Co., Orlando
"Environmental Equipment for Nuclear Studies," T. B. Morse, Sandia Corporation

Session H: "Basic Planning for Environmental Testing," SEMINAR. Gerald Marks, Office of Assistant Secretary of Defense; Topic: "Policy Criteria; Engineering Contact Points"; William B. Brierly, Quartermaster Corps, Army R & D Command, *Topic*: "Army Environmental Criteria Standardization *vs* R & D. Trends"; David Askin, Ordinance Corps, Frankford Arsenal, *Topic*: "Army Test Methods; Marshalling of Lab Test Facilities"; Wayne B. Yarcho, Air Force, Wright Air Development Center, *Topic*: "Air Force Standardization Tasks"; E. F. Seaman, Dept. of Navy, Bureau of Ships, *Topic*: "The Engineering Planning Approach; International Standardization."
"Extreme High Temperature Tests & Facilities for Missile Components," A. B. Billet, Vickers Incorporated.

Session I: "Environmental Testing of Automotive Equipment P. H. Pretz, Ford Motor Company
"A Synopsis of Natural Environments to Heights of 1,000 Km," A. P. Harris and E. W. Parrott, Canadian Military Electronics Standards Agency
"Designing for Human Subjects in Environmental Engineering," D. O. Blake, Pratt & Whitney, Canada

12:00 Noon to 1:45 P.M.
Luncheon. Speaker: Kurt R. Stehling, Naval Research Laboratory, "Space Satellite and Space Travel"

2:00 P.M. to 4:45 P.M.
Session J: "Unique Environmental Test Facilities of the Detroit Arsenal." Maj. G. A. Tuttle, Detroit Arsenal.
"Environmental Test Facilities for Ramjet Engines and Components," Leigh E. Dunn and Jack M. Mason, Marquardt Aircraft Corp.

Session K: "Environmental Testing of Solid Propellant Rockets," J. A. McBride, Rocket Fuel Div., Phillips Petroleum Company
"Environments of Noise and Air Conditioning in the Convair 880 Jetliner," Meyer Lepor, Convair, San Diego

The Technical Meeting Committee

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Program: A. B. Billet, Vice Pres. of IEE and Staff Engineer, Vickers, Inc.

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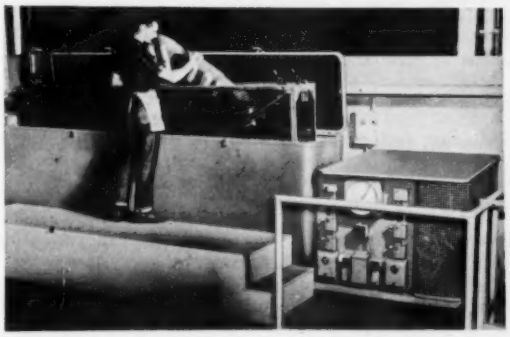

Stabilization of austenitic stainless steels and tools is done at the Columbus Div. of North American Aviation with the low-temperature chilling machine by Cincinnati Sub-Zero Products shown here. The unit achieves complete transformation of steel from austenite to martensite without warpage. The model 3SR 120-47 was developed to eliminate many of the problems that occur in the conventional heat treatment of stainless steel and will be used extensively for the elimination of retained austenite in the new steels. Rocket and missile steel, for example, must retain hardness and dimensional stability at elevated temperatures.

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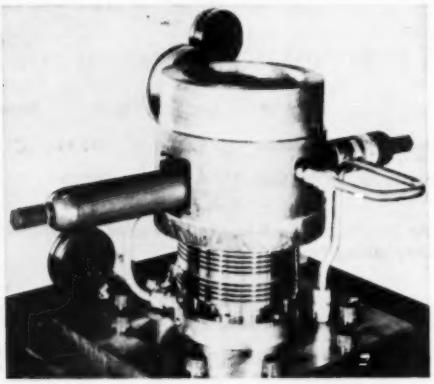

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Organizational Aspects of the Environmental Problem

RAY M. DANIEL,
Northrop
Aircraft, Inc.

At a time when the Nation is turning a critical eye upon itself, this writer points a stern finger at an area in our defense effort where there seems to be room for improvement.

Industry has found itself in the position of being obligated for performance of weapons systems under environmental conditions it knows little about. This is a current problem, not because the situation is new, but primarily because weapon performance, complexity, and reliability requirements have increased environmental range, variation, and effect to an extent that we can no longer ignore the situation.

Industry's approach to this environmental problem has been random constructive criticism of customer specifications in an attempt to make them more adequate for detail problems of individual weapon systems. It could be inferred from this approach that industry's "policy" is to rely upon the Customer to specify all environmental criteria for each weapon system. This, in fact, is not true; industry hasn't established a policy. Some companies do, to a certain extent, try to determine and use environmental criteria peculiar to the individual product. Many don't even recognize that they should. Of the reasons for the existence of this apparent policy, these are probably the more predominant:

> Too many of us are so confounded by detail problems that we don't have or take time to consider broader aspects. Those that do recognize that a logical approach involves considerable change and responsibility, involving both thought and effort that we "don't have time for." (Leave it alone and maybe it will go away.)
>
> The equipment manufacturer is understandably desirous of standardization and is therefore interested in standard requirements for all product applications. (The "yellow-dot" era would be so nice to come home to.)

Two Major Problems

Unfortunately, the customer has not yet been able to define environmental criteria to the extent required for satisfactory industry performance, nor does this approach appear practical, even if separate customer specifications were created for each weapon system. The customer doesn't want this responsibility, and he is so removed from the problem that he cannot accept it. We have then two major problems:

> From a technical standpoint, we have a problem in establishing realistic or "relatively exact" environmental criteria for all portions of each weapon system.
>
> From an *organizational* standpoint, we have the problem of establishing general areas of customer and contractor responsibility for the solution of the technical problem.

By definition, the organizational problem must be resolved before effective concerted action can be expected in solution of the technical problem. In an objective analysis of the organizational problem, we must consider that collective environment is divided into two significant areas:

> Environment characteristic of the *use* of the item.
> Environment characteristic of the item *itself*.

Criteria, for "use environment" is as much a responsibility of the user as other use criteria, such as performance, reliability, etc. Similarly, environmental criteria dependant on the product are as much a part of responsibility delegated (contractually) to the producer as are responsibiliteis for performance, reliability, etc.

Who Defines Environments?

Using this as a basis for dividing the technical problem into areas of responsibility for the customer and contractor, we find that it applies equally well to the relationship between the weapon system manufacturer (contractor) and the military (customer) as it does to the relationship between the equipment manufacturer (contractor) and the weapon system manufacturer (cus-

(Continued on next Page)

tomer). In each case, the *immediate* customer must be responsible for defining environment, but cannot with any accuracy define the environment that the contractor "builds-into" the product. This responsibility he must *specifically* delegate to the contractor.

The division of responsibility for definition and use of collective weapon system environmental criteria should therefore be as follows.

IDENTITY	FUNCTION	RESPONSIBILITY
Military Services	Prime Customer	a) Determine and define the general sphere of operational environment applicable to *any* weapon system (global climatic conditions, transportation and handling environment under various use conditions, etc.) b) Determine and specify operational environment of *each* weapon system by comparison of general data (item a) with specific objectives (performance, reliability, mission, etc.) of the system. c) Collect and correlate industry-measured environment for use by industry in initial prediction of "built-in" environment. d) Review contractor environmental specifications.
Weapon System Manufacturer	Prime Contractor	a) Initially predict and specify environment within the weapon system by system analysis and use of historical data (item c, above). b) Experimentally determine or verify environmental criteria during weapon system development, and so modify specifications. c) Determine and specify environmental test conditions and procedures for all directly supplied components of the weapon system.
Weapon System Manufacturer	Sub-Customer	Determine and specify the operational environment, and test conditions and procedures applicable to *each* sub-contracted item.
Equipment Manufacturer	Sub-Contractor	Same process relative to the sub-contract item as that of the prime contractor relative to the weapon system. Tangible evidence of this process (specifications, experiment, etc.) will depend upon the predictable effect of operational environment, and the nature and complexity of the item itself.
Equipment Manufacturer	Sub-Customer	Determine operational environment of each sub-component, and select or additionally sub-contract to these requirements.

Major Stumbling Blocks

It should be apparent that this process follows accepted organizational principles; also, that the differences between this and current processes are slight. Yet these slight differences—largely of organizational nature —are major stumbling-blocks. Primarily they are:

Objectives and policy are not clearly defined. They are left to the interpretation of affected customer and contractor personnel, guided by somewhat conflicting procedural evidence. This often results in a confused, uncoordinated effort.

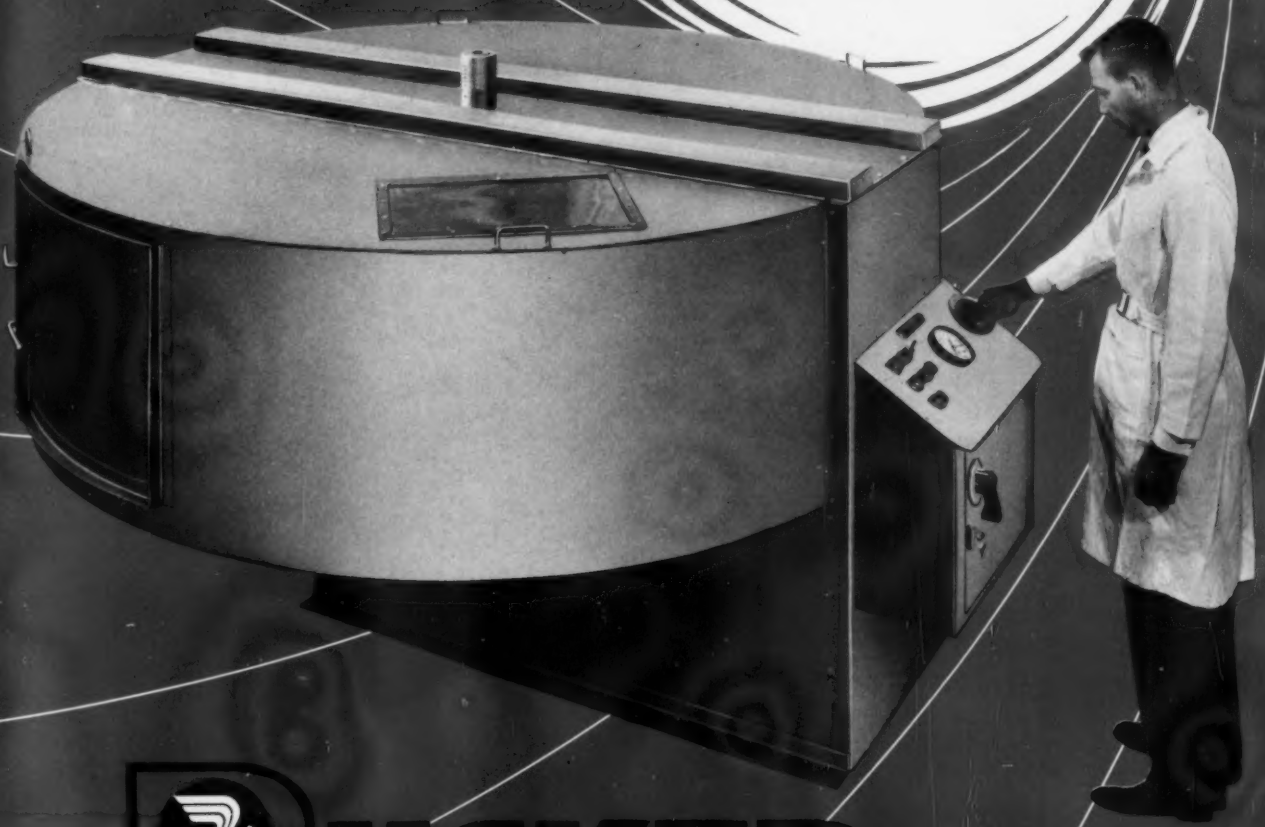
Responsibility delegated is often neither clearly defined nor sufficiently homogenous to allow complete acceptance.

Customer activity overlaps what should be contractor responsibility to an extent that the contractor can and often does avoid responsibility in areas where only he can do the job right. This is particularly true in the area of environmental specifications. MIL-E-5272, for example, is generally inadequate in satisfying customer responsibility (operational environment of an individual weapon system), and understandably inadequate in satisfying contractor responsibility (environment within the

(Continued on Page 20)

Precision TESTING of simulated operational G-LOADINGS

—under MIL-E-5272A



RUCKER Centrifuge ACCELERATION TEST MACHINES

SERIES 1

RUCKER

Centrifuge ACCELERATION TEST MACHINES

FAST ACCURATE G-TESTING—as required by MIL-E-5272A.

The Rucker Centrifuge Acceleration Test Machines, Series 1, are precision-engineered for accurate pre-testing of components, instruments and complete assemblies employed in aircraft, missiles and rockets under simulated operational acceleration loadings in the 1 to 150 G-range. They are ideally suited both for exacting laboratory testing and for mass production-line testing procedures. Smooth, low sound level performance, permits the machine to be operated satisfactorily in relatively confined areas.

Hinged twin lid sections with Plexiglass observation window and hinged side access doors can be opened for easy accessibility to rotor arm test chamber. Side base plate is removable for ready access to power spindle and motor drive. Periodic routine inspection and cleaning—with minimum maintenance are easily accomplished.

FULL RANGE OF MODELS AVAILABLE

SERIES 1

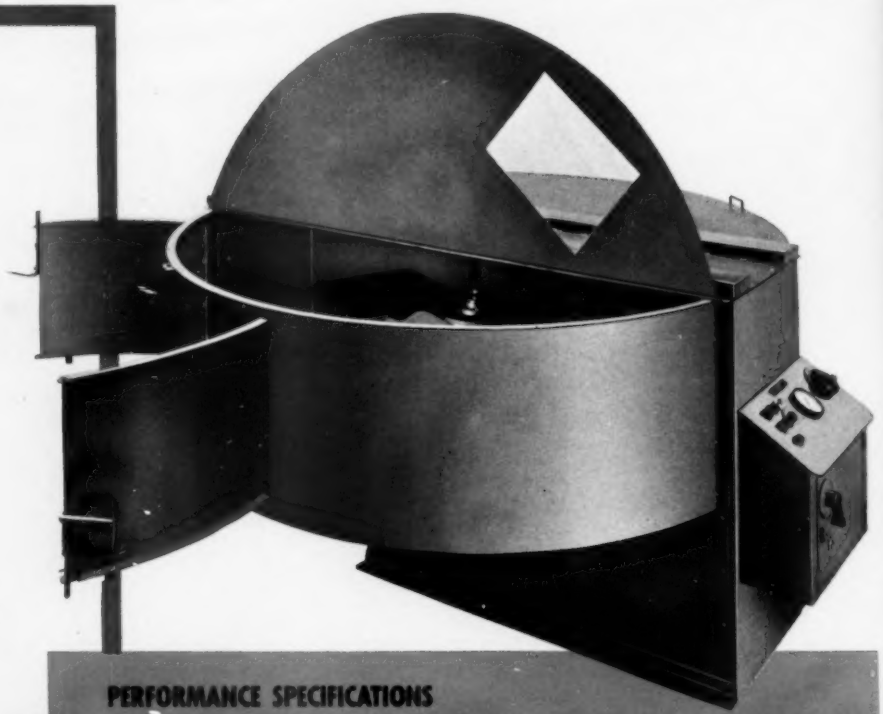
G-rating: from 1 to 150
Test radius: from 18" to 46"

SERIES 10

G-rating: from 1 to 150
Test radius: from 96" to 240"

SERIES 20

G-rating: from 1 to 100
Test radius: from 264" to 420"



PERFORMANCE SPECIFICATIONS

SERIES 1

	Model RCT-1	Model RCT-2
G-Rating	120 G at 26"	100 G at 46"
Test Radius	18" to 26"	22" to 46"
Max. Specimen Size	8" x 8" x 8"	24" x 24" x 18"
Centrifugal Capacity (Maximum)	3600 G-lbs.	5000 G-lbs.
Weight Capacity (Nominal)	30 lbs. @ 120 G	50 lbs. @ 100 G
Weight Capacity (Maximum)	40 lbs. @ 90 G	100 lbs. @ 50 G
Acceleration Time	10-45 Seconds	30-60 Seconds
Deceleration Time	10-45 Seconds	30-60 Seconds
Horsepower	1 HP	2 HP
Weight (Basic Unit)	1000 lbs.	4000 lbs.

Maximum variation from set speed:
WOW: 0.5 %, above 10[illegible] r.p.m.
DRIFT: 0.1 % per minute, above 10[illegible] r.p.m.

Note: Both machines are structurally designed for continuous testing at higher speeds. With only an increase in HP, the Model RCT-1 is capable of 150 G's at 3,000 G-lbs., and the Model RCT-2 is capable of 150 G's at 5,000 G-lbs.

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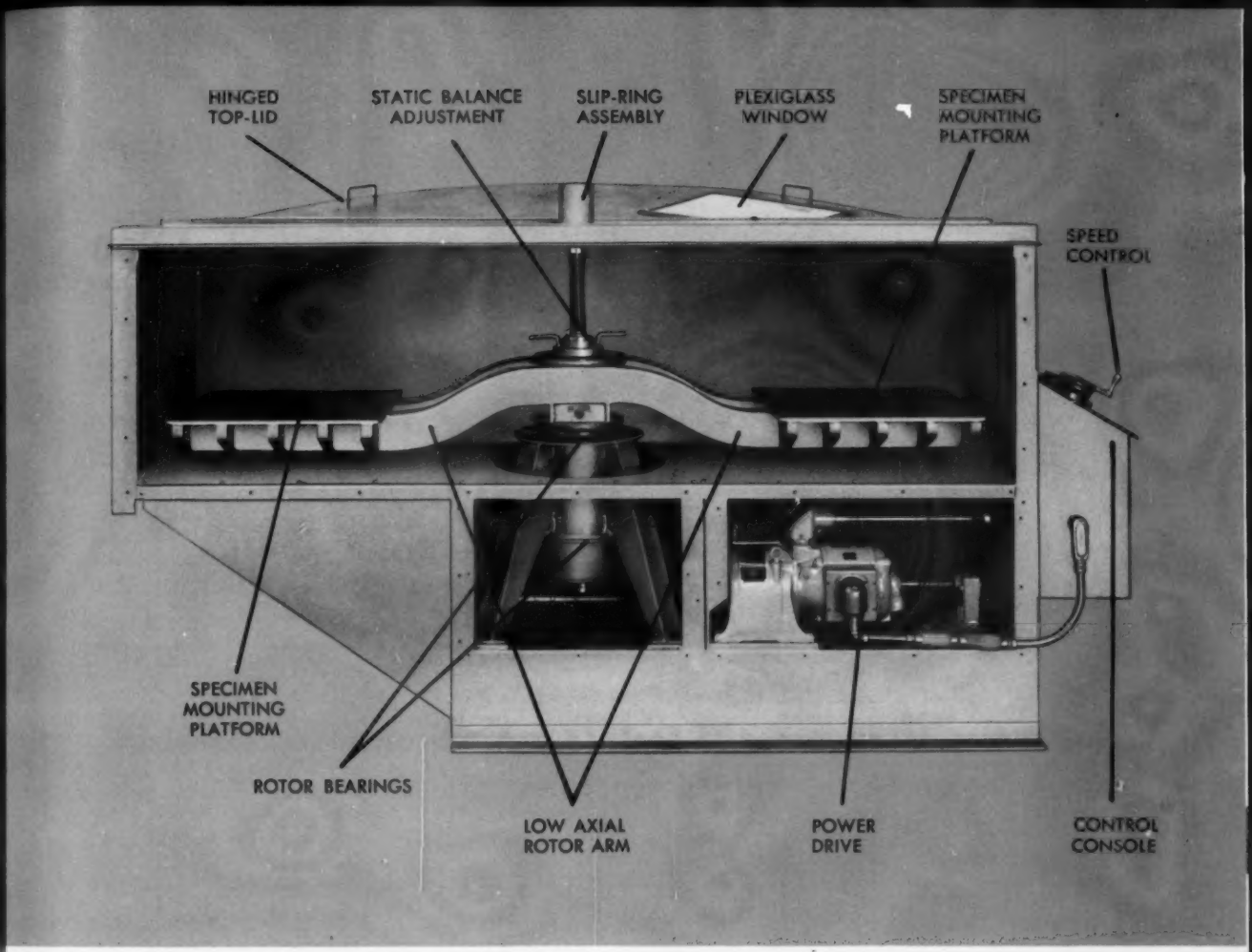


OPERATIONAL-PERFORMANCE FEATURES

ROTOR ARM: The exclusive Rucker low-axial rotor arm design eliminates bending moment effect resulting from radial acceleration force of specimen mass, thus providing extreme stability throughout the test range. Identical mounting platforms on each end of rotor arm provide a simplified means of firmly securing specimens or compensating counterweight assemblies.

STATIC BALANCE: The rotor arm is supported at its center on ball bearing pivots to permit static balancing. After balance is established, rotor arm is locked in normal level position by capstan nut.

DYNAMIC BALANCE: Symmetrical design of the rotor assembly assures dynamic balance. Rotor, bearings and spindle are engineered for extra strength and rigidity. They will withstand the maximum unbalanced forces resulting from loss of counterbalanced weight or specimen during operation.

SAFETY: Heavy 3/16" steel plate safety shell with hinged side access door, encloses rotating assembly to safeguard personnel from any possible dislodged objects. Electrical interlocks prevent starting machine while side doors are open. Also, a hinged double cover assembly with Plexiglass observation window affords further protection and minimizes windage power loss by effectively reducing air pumping action of high speed rotor.

ACCURACY: The high inertia designed into rotating parts damps out external vibrations and assures minimum WOW and DRIFT.

INSTALLATION: Ruggedly built of demountable sections, the machine can be readily moved through a standard 36" door frame for installation. Main base of unit provides for rigid bolt down mounting. No special foundations are required.

ACHINE INSTRUMENTATION CONTROL:

in Power Feeders: 220 or 440 volt, 3 phase, cycle. Control circuit power 110 volt obined from main power feeder by step down nsformer in control cabinet.

ed Indication: Available through built-in C. tachometer, generator and meter as ndard equipment. Other precision indiors furnished under optional accessories.

ctrical Control and Power Circuitry: Included in ntrol cabinet are magnetic starter, control cuit transformer, interlocks, lock switches, ntrols, and indicating devices internally red ready for connection to power supply.

wer Spindle Drive: Drive mechanism provides finitely variable rotor speeds, controlled calibrated hand-wheel on the instrument nel. Rotor arm can be quickly brought om "dead stop" to testing range on a proction line schedule. Also, the rotor arm n be brought to a fast decelerated stop by eans of a brake control on the console.

OPTIONAL ACCESSORIES:

e following accessory items can be furnished at ditional cost –

ctrical Slip Ring Systems: Slip ring systems are standarded for basic instrumentation requirements and wer needs. Basic assemblies provide a compact sysm of low noise coin-silver rings, stationary silver aphite brushes, and appropriate shielded leads, conniently terminated at numbered external binding sts for use in circuit set-ups.

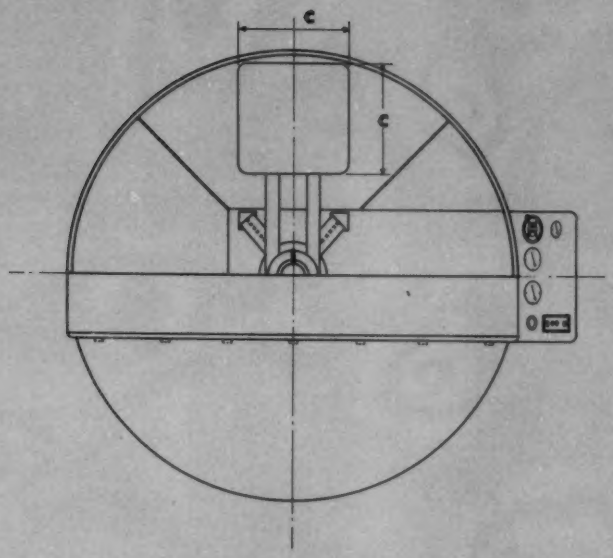
-Ring Commutator Assembly: Includes, as standard uipment:

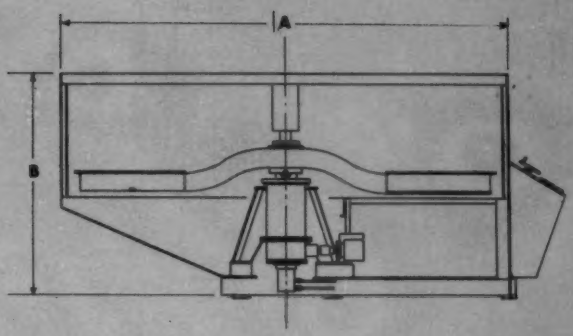
a. 2 power rings rated 5 amps. at 110 volts A.C.
b. 10 instrument rings with shielded leads rated 5 amps. at 110 volts A.C. Other assemblies furnished upon request.

draulic or Pneumatic Systems: By means of rotary joint semblies, a suitable system can be installed at the ctory to carry actuating air, vacuum or liquids from ntrol panel connections to suitable outlets on the tor arm for hook-up to test specimens. Specify size nd pressure range.

Speed Measurement: In addition to standard tachometer indicator furnished, high accuracy timer-counters, pulse counter, or strobe system can be provided to meet specific requirements.

90° Specimen Rotation: Special rotating specimen platform can be provided to meet Procedure I of acceleration tests under MIL-E-5272A.





DIMENSIONS			
MODEL	A	B	C
RCT-1	52"	42"	8"
RCT-2	102"	54"	24"
Certified dimensional drawings furnished with order.			

Rucker Offers a Full Range of Centrifuge Acceleration Test Machines

The following standard testing machines are available in a complete range of sizes and G-ratings.

	Arm Radius	G-Rating	Centrifugal Capacity (G-lbs.)	Specimen Size	Specimen Weight (lbs.)
SERIES 1:					
Model RCT-1	26"	120G	3,600	8" x 8" x 8"	30-40
Model RCT-2	46"	100G	5,000	24" x 24" x 18"	50-100
SERIES 10:					
Model RCT-11	96"	150G	45,000	30" x 30" x 30"	300-600
Model RCT-12	144"	65G	30,000	36" x 36" x 36"	300-600
Model RCT-13	240"	65G	30,000	42" x 42" x 42"	300-600
SERIES 20:					
Model RCT-21	264"	100G	400,000	30" x 30" x 60"	2000-4000
Model RCT-22	324"	100G	400,000	30" x 30" x 60"	2000-6000
Model RCT-23	420"	100G	400,000	48" x 48" x 60"	2000-8000

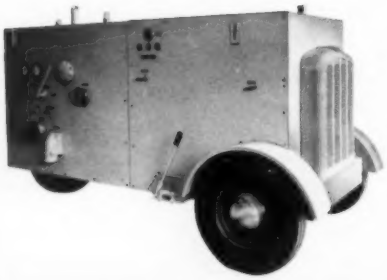
For complete specification on any model, request Technical Bulletin. Modifications of these basic models to meet specific problems or requirements can be made. Other machines can be custom-designed to meet special needs. Submit requirements to Rucker Engineering Department.

Rucker Model RCT-21

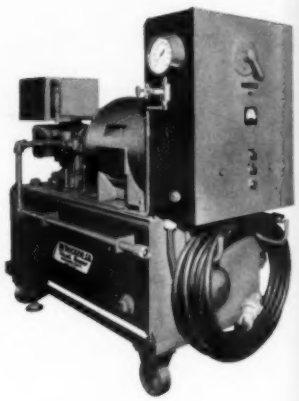
View of 22' radius arm and powerhead installed in test pit. This large Series 20 unit is designed for testing 4,000 lb. specimen at 100 G-rating.

OTHER RUCKER PRECISION-ENGINEERED EQUIPMENT

TEST BENCHES:
Standard or specially designed stationary and portable test benches for precision testing of all types of hydraulic and pneumatic components or systems.



HYDRAULIC POWER UNITS:
Stationary or Portable Packaged Hydraulic Power Units, for local or remote operation with Pressures to 5,000 PSI, for Aircraft and Missile development, production testing, and flight line check-out.



HI-PRESSURE GAS BOOSTERS:
Stationary or portable high pressure gas boosters for compressing helium and nitrogen up to 10,000 p.s.i., for missile development and production testing or flight line check-out.

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MANUFACTURING FACILITIES

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"FIRST AND LARGEST IN ENVIRONMENTAL TEST EQUIPMENT"

RANDOM AND COMPLEX-WAVE VIBRATION TEST SYSTEMS

UNO HEDIN, Ling Electronics, Inc.

Ling Electronics has pioneered equipment in this field. The author presents here a brief theory of operation.

As the speed of aircraft and missiles has increased, new forces have been added to the reliability problems of mechanical components and assemblies. Today, many specifications call for random and complex-wave vibration testing in addition to sine-wave. Random noise vibration testing has proved to be such a useful tool that special equipment has been designed to drive existing shaker tables. This article is an introduction to the operation of the new electronics driving and control systems required.

Power for driving shaker tables is generated in any one of a series of stable power amplifiers. Smaller amplifiers, from 1 KVA to 40 KVA, are provided with a range of 8 output impedances. This allows great flexibility in choice of shaker for each amplifier. Larger amplifiers, 60 KVA and 90 KVA, are equipped with 4 output impedances with 4 taps for optimum operating conditions with the three largest shakers. All impedance switching is controlled from the front panel of the amplifiers.

The two proper amplifier operating impedances, the necessary output stage KVA rating, vacuum tube emission, dissipation and drive requirements can be determined by examination of the specific shaker characteristic curves.

Instrumentation

The control console, rack mounted or desk type, consists of a group of electronic and electromechanical components whose overall function is to produce vibration of the specimen in exact accordance with the system input voltage signal. This may be a complex wave, gaussian noise, sine wave mixed with noise or a tape-recorded in-flight vibration signal. The console contains random and sine wave signal generators, a mixing amplifier, tape recorder, band limiting filters, frequency equalizer for both shaker compensation, and spectrum energy distribution control.

Operating Procedure

A rapid frequency compensation and setup are possible. With the specimen mounted on the shaker table and an accelerometer attached at the specimen mounting point, as called for in the test specification, the equipment is readied for a servo-controlled sine-wave

(Continued on next Page)

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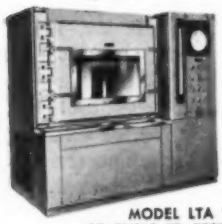
Advanced design features, highest quality materials and superior craftsmanship go into every M & M test unit to assure accurate tests and dependable operation. Before you specify or buy any test equipment—see what Murphy & Miller has to offer you.

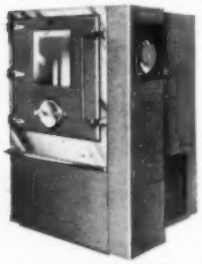


MODEL LTA 12
12 CUBIC FT. TEST SPACE

ALTITUDE SIMULATION UNIT

- Altitude Ranges over 200,000 ft.
- Temperature Range from + 1200°F to —120°F
- Humidity cycle 20% to 95% from + 35°F to 185°F
- New design—greater capacity per horsepower—lower operating cost . . . greater efficiency

Available in units with 12 to 64 cubic ft. of test space, M & M Altitude Simulation Chambers offer every standard and optional feature for faster, more flexible testing. Optional features include Program Controlled Heating, Cooling and Humidity Cycles, Automatic Recorders, Special Wiring, etc. etc.

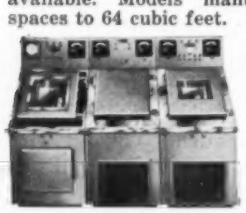


MODEL H 12
12 CUBIC FT.
TEST SPACE

HUMIDITY TEST CABINET

- Provides Relative Humidities between 20% and 95%
- Temperatures from + 185°F to —35°F
- Instant response of humidity system insures accurate testing
- Uniform temperature and humidity throughout test cycles.

High capacity heating, refrigeration and forced air systems insure fast, accurate temperature rise and pull-down Program control cycle for temperature, humidity and cooling available. Models manufactured with test spaces to 64 cubic feet.



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- Exclusive sloping front for easier viewing . . . faster loading
- Available in single units or combinations

Compact, portable and inexpensive, M & M Slope Front test cabinets are made for low temperature (dry ice refrigerant) Fungus, humidity testing. Cabinets are fully automatically controlled.

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scan at 1.0 g vector level (a lower calibration level may be used if this level may be damaging to the specimen). A single scan of the desired frequency band is made in a sweep time of approximately five minutes. An X-Y recorder is used to plot the audio-frequency output of the servo amplifier vs. operating frequency.

Knowing that g excitation at the specimen was held consant by the servo system and that the input voltage to the servo was constant with frequency, we attain a plot of the desired transfer characteristic of the compensating equalizers. The power amplifier and exciter can now be turned off and left off during the equalizing procedure.

By means of push-button switches the servo system is replaced in the circuit with compensation equalizers (graphic equalizers and peak-notch filters). While the oscillator is being tuned manually, the graphic equalizers and peak-notch filters are adjusted so that the X-Y recorder pen follows the previously recorded compensating curve. This completes system equalization. With the power amplifiers and exciter again turned on, any voltage applied at the system input will now be reproduced at the specimen attachment point as a proportional acceleration function.

The input signal may be random noise with uniform energy distribution, energy may be unequally distributed over the frequency spectrum by means of a second graphic equalizer, or any type of random signal may be combined with fixed or variable frequency sinusoids by means of a mixing amplifier.

Two types of protective devices are a must if the occasional high-amplitude noise pulses are not to result in shaker over-travel. One device is a frequency-sensitive clipping amplifier that clips low-amplitude, low-frequency components. At levels below the danger point, neither the frequency nor the amplitude of the signal is affected.

The second protective device is a high level dynamic braking and amplifier deenergizing circuit. If, for any reason, a fault occurs from operation error or equipment failure that results in shaker over-velocity, over-travel, over-voltage, or over-current, a thyratron triggers the armature protector circuit. Within microseconds large thyratrons discharge the power amplifier filter condensers and short-circuit the amplifier output transformer. This instantly stops all power delivered to the shaker and applies heavy dynamic braking action to the moving shaker armature.

The two shaker protective devices, when combined with amplifier and operator protective devices, make high-power electronic drive systems feasible and allow uninhibited random or sine-wave testing. Operator errors result only in momentary shut-down and negligible loss of test time.

END

NEW IEE MEMBERSHIPS

A list of those who have joined since the last issue of the Environmental Quarterly. Where home addresses are shown, company affiliations appear in parentheses.

MEMBERS

California

Cameron G. Pierce, Ling Electronics Inc., 5120 W. Jefferson Blvd., Los Angeles
Loren A. Patrick, F. J. Stokes Corp., 15 N. Euclid, Pasadena

Connecticut

Hugh L. Cox, Raymond Engineering Lab., Inc., Smith St., Middletown

Illinois

Theodore C. Dungan, Hoffman Electronics Corp., Semiconductor Div., 930 Pitner Ave., Evanston
Edward A. Roberts, Union Thermoelectric Corp., 7212 Circle Ave., Forrest Park
Martin H. Dorsey, (Motorola Inc.), 443 N. Princeton Ave., Villa Park

Maryland

Albert E. Armstrong Jr., (Westinghouse Electric Co.), 104 Bliss Lane, Glen Burnie

Massachusetts

Haig A. Tatosian (Technical Instruments, Inc.), 94 Page Rd., Bedford
Erik M. Gelotta, M. I. T. Instrumentation Lab., 68 Albany St., Cambridge
Emanuel Munzer, (Raytheon Wayland Lab.), 9 Maureen Rd., Farmingham
Robert Joel, Detroit Controls Div., Control Engineering Unit, 100 Morse St., Norwood
Harry D. Woodlee, Raytheon Manufacturing Co., Wayland Lab., Wayland

New Jersey

Kenneth A. Wilks, (Applied Science Corp. of Princeton), 145 Academy St., Hightstown
Boris Mangolds, (Reaction Motors, Inc.), 69 Bromley Rd., Nutley 10
Bartholomew C. Countey, (Ref-Air Corp.), Alps Road, P. O. Box 515, Packanack Lake

Ohio

Jack N. Schoenberger, Bowser Morner Testing Labs., Inc., 141 Bruen St., Dayton

Pennsylvania

Kenneth W. Martin, Clifton Precision Products Co., Broadway at Marple, Clifton Heights

GOVERNMENT AGENCIES

U. S. Army Chemical Corp., Engineering Command, Army Chemical Center, Md.
Rep: H. O. Huss, T. M. Vining
U. S. Naval Training Device Center, Sands Point, Port Washington, N. Y.
Rep: Wm. K. Ballance, R. S. Gittelson
Quality Evaluation Laboratory, U. S. Naval Torpedo Sta., Keyport, Wash.
Rep: R. R. Peterson

COMPANY MEMBERS

International Business Machines Corp., Owego, N. Y.
Rep: Kenneth Koon

IEE Nominating Committee

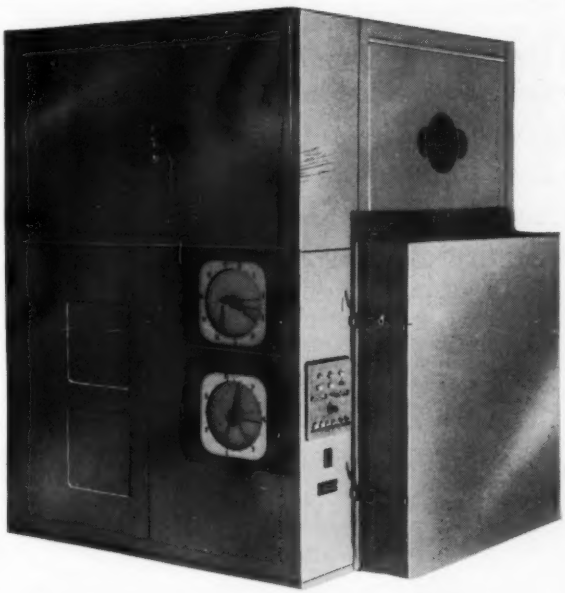
Henry F. Sander, IEE President, has announced the appointment of the nominating committee for 1958-59. Sander is director of Standard & Quality Controls, Vapor Heating Corporation. The committee includes Sander and the presidents of the New York, Chicago, and Detroit local chapters. These are, respectively, J. C. Ward, Head, Environmental Sect., General Precision Laboratory, Inc.; John R. Boyle, President, Boyle Engineering Labs.; and A. B. Billet, Senior Staff Engineer, Aero Hydraulics Div., Vickers Incorporated. New officers of the IEE will be announced in the next issue of the *Environmental Quarterly*.

"...the impossible takes a little longer"

HI-LOW TEMPERATURE CHAMBER

ALL IN ONE CABINET

-100°F TO +1000°F



"... the impossible takes a little longer."

Well, here it is — that impossible-to-do high and low temperature chamber −100°F to + 1000°F ALL IN ONE CHAMBER.

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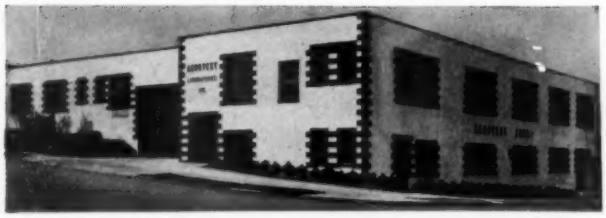

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Letters to the Editor

Dear Sir:

We read with interest the article presented in Vol. 3, No. 4, entitled "Shock Testing Procedures and Equipment" authored by Mr. C. A. Mills of Canadian Westinghouse Company, Limited. We feel that Mr. Mills made a definite contribution in providing a consolidation of shock testing procedures and methods as well as in the description of various types of shock testing equipment. However, we would like to point out that the author has allowed himself to become trapped by the frequency response of crystal accelerometers and filters in presenting the time history relationships obtained from sand drop shock testing machines and from lead drop testing machines. At least this is the case if he concludes that Fig. 5 and 8 are any criterion of his test results.

These are not representative shock pictures of the time history obtained from the free fall drop on a sand drop testing machine nor are they representative of shock pulses obtained on lead shock testing machines. They are, instead a graphic illustration of the misinterpretation that can result from the use of measuring systems that have very poor low frequency response characteristics.

I refer you and Mr. Mills to a report recently published by the General Electric Co. entitled "Comparison of Barry Shock Tables." This report can be obtained from the library at the G. E. Light Military Electronic Equipment Dept., French Road, Utica, The authors are D. J. DeMichele and M. E. Gurtin, and the report, No. R57EML40, is dated 3 Sept. 1957. We quote from page 4:

"The waveform photographs shown in the attached Fig 1 and the graph in Fig. 2 demonstrate the effect of the low-frequency response that the measuring system has on the measured waveform. The lower the low-frequency response, the closer the measured waveform is to the true waveform. A reasonable system low-frequency response is 0.2 cps. If an a-c accelerometer (i.e., piezoelectric crystal) is used, care must be taken to insure an adequate low frequency response."

• • •

The General Electric Report shows that repeatability of sand drop testing up to a given level can be obtained in an accurate manner when the proper instrumentation and the proper calibration and testing procedures are utilized. Our comments as a manufacturer could perhaps be taken lightly except that the effect of poor system low-frequency response is shown in the author's Fig. 8 for a lead drop decelerator. As a result, it is obvious that the writer has not considered this in presenting his discussion. Properly instrumented shock pulses utilizing strain gage accelerometers such that they are flat down to a dc level and utilizing filters in the network if necessary that have no greater than .2 cps lower cutoff frequency will insure that realistic positive acceleration pulse is obtained and that the area under the pulse can be related to the height of free fall within an accuracy of ± 15 per cent.

We would also like to point out that indent type accelerometers usually have inaccuracies up to 100 per cent error. This is due to the dynamic characteristics of materials when subjected to varying shock conditions. These dynamic characteristics cannot be determined by static force deflection testing as implied by the author since the rate of loading and the stiffness of the indentor components will vary, depending on the shock test application.

• • •

RUSSELL T. LOWE
Assoc. Mgr. Engineering
Barry Controls Incorporated

Dear Sir:

The Baroswitch Tester, Model III, was designed to fulfill a particular need at Sandia Corporation. Its features were directed particularly toward accuracy, repeatability, and the number of contacts which may be tested simultaneously. A definite advantage

(Continued on Page 19)

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Here is your chance to make a name for yourself and win $100.00. The Environmental Equipment Institute wants to encourage the exchange of technical information and to recognize outstanding contributions to the field of evironmental simulation and testing. It also wants to stimulate the flow of high quality articles to the *Environmental Quarterly*. To achieve these ends, it has announced that it is establishing two annual cash awards of $100 each.

These awards will be presented to the authors of the most outstanding papers presented in each calendar year in the *Environmental Quarterly*. There are no restrictions as to author or subject. The requirements are simple: the paper must be an important contribution to the field, and it must be published in the *Environmental Quarterly*. One award will be general, and may be presented for any article. The other will be given only for a paper that was first presented at an IEE local chapter meeting.

Although two awards have been set up, it is possible for the judges to award both to the same author. On the other hand, if the judges feel no paper deserves recognition, no award will be made in either or both categories for that year.

The judges will be appointed by the Institute of Environmental Engineers, and the first contest starts with calendar year 1958. The President of the Environmental Equipment Institute wil present the first two cash prizes at the joint meeting of the two Institutes in April, 1959.

To give your article or paper the best chance for publication, the IEE suggests that you query the editor of the *Environmental Quarterly* for mechanical requirements before final preparation.

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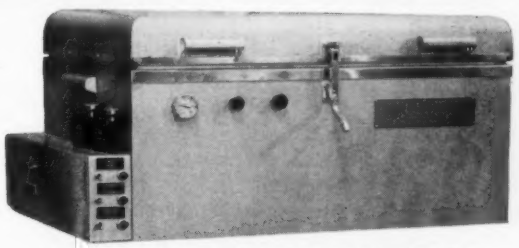

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ACOUSTIC ENVIRONMENT

(*Continued from Page 5*)

intensity sound. The same is true for vibration pickups.

A rate gyro, magnetic reed relay, transistors, diods, resistors and capacitors passed tests conducted in discrete-frequency sound fields. However, large and varied samples, extended test periods, higher sound levels, "white noise" sound or other technique variants must be tried in an effort to learn about the acoustic sensitivity of these components.

Conclusion

The evaluations conducted in the Bell Aircraft acoustic chambers produced electron tube, relay and instrument failures. Airborne components that are selected for operation in high-intensity noise areas must be carefuliy specified and tested. If the acoustic environment is ignored, reliability is seriously jeopardized.

Because the sound levels about and within aircraft and missiles are related to Mach number, acoustic techniques and acoustically-immune equipment will continue to increase in importance. The high-intensity sound environment must be considered, investigated, and reported in an effort to solve the new problems developing daily.

References

(1) Proceedings of the IEE, April, 1957; three papers: *Methods for Estimating Acoustic Environment for the B-58 Weapons System*, E. H. Stepp, Convair; *Some Results of Structural Tests Under High-Intensity Noise*, H. H. Hubbard, NACA; and *Problems in Acoustically Induced Equipment Failure*, Dr. I. Dyer and Dr. J. Baruch, Bolt, Beranek and Newman, Inc.

(2) F. Mintz and M. B. Levine: *Environmental Testing of Small Electronic Components at High Sound Intensities*, Paper 54-

(3) *Jet Efflux—A Symposium*, J. Royal Aero Soc., Vol. 61, No. 544, 422, A.I.E.E. Fall General Meeting, 1954. February 1957, P. 103-115.

(4) R. Bird: *The Measurement of Microphony in Valves, Electronic Engineering*, Vol, 23, Nov. 1951, P. 429-431.

(5) L. L. Beranek: *Acoustics*, McGraw-Hill, 1954, P. 28-36, 286-289.

(6) P. M. Belcher, W. Fricke, K. R. Jackman and R. H. June: *High Intensity Acoutical Test Facilities, Loudspeakers and Sirens, Inst. of Aero. Sciences*, Feb. 1957.

(7) W. Fricke: *A Stationary Wave Resonant System to Produce High Sound Pressure Encountered in Missiles*, Paper 337-56, Am. Rocket Soc., Sept. 1956.

(8) Department of Defense: *Individual Military Specification Sheet MIL-E-1/12A*, Ref. 4.9.20.3.

(9) Department of Defense: *Individual Military Specification Sheet, MIL-E-1/188B* Ref. 4.9.20.3.

(10) R. H. Jacobson: *The Scream of a Jet—in a Six-Inch Test Cell, Elect. Industries & Tele-Tech*, Feb. 1957.

END

LOCAL CHAPTERS

(Continued from Page 3)

On Dec. 5 this Chapter sponsored E. F. Dertinger, Head, Reliability and Weight Control Sec., Missile Guidance Dept., Am. Bosch Arma Corp., in a timely lecture on the "Role of Environmental Testing in Missile Programs." Dertinger emphasized the dangers involved in bypassing environmental tests of missile components, and pointed out the need for extreme reliability of components in missiles. He stressed the need for testing to failure or to destruction under extreme environmental conditions while simultaneously gathering data for statistical analysis.

At an executive session prior to the dinner meeting, J. C. Ward, General Precision Laboratory, Chairman of the Chapter, appointed standing committee chairmen for fiscal year 1957-58, and assigned Roger Amorosi, IEE National Vice-President (Pres., Parameters, Inc.) to form the Chapter nominating committee. Appointments: Program—B. Friedman, Tenney Engineering; Publicity—S. Vavoudis, General Precision Laboratory; Membership—R. Rudkin, American Bosch Arma Corp.; and Professional Relations—N. Ponge, Burgoyne Testing Laboratories.

CHICAGO—The Greater Chicago Area Chapter held three 1957 Fall meetings at monthly intervals, starting with a dinner meeting Sept. 18 in the Western Society of Engineers Bldg. Program consisted of a talk on "Piezo Electric Transducers, Their Design Applications and Limits," by Wilson Bradley, Gen. Manager of ENDEVCO Corporation. Bradley stressed two points on transducer selection: (1) Natural frequency of the transducer should be a minimum of 5 times the highest frequency to be generated or measured; (2) close consideration to wave purity and its effects on the indicated output of a transducer. The destructive force is measure in terms of acceleration and, therefore, the transducer

(Continued on Page 19)

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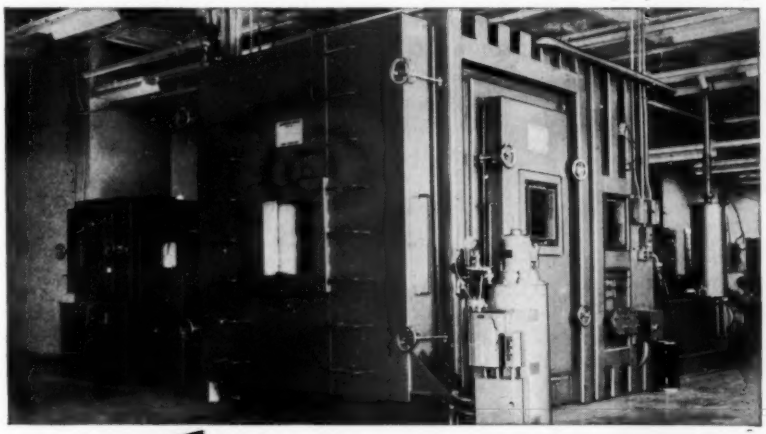

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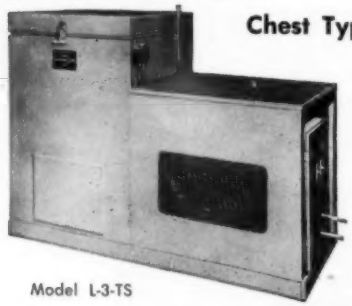

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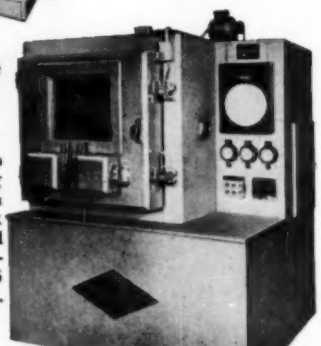

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IEE ANNUAL MEETING

IEE Second Annual Meeting, New Yorker Hotel, New York City, April 17 and 18. For program, see page 6.

LETTERS

(Continued from Page 11)

of this tester is the short time required to perform a series of tests. Only 10 minutes is necessary to complete four tests on 24 contacts.

The present tester may be too complex for widespread application but some of the ideas might readily be used by readers of the *Environmental Quarterly* who test pressure actuated switches as a part of their business. Following is a description:

The Baroswitch Tester is a device for checking the performance of pressure actuated switches operating in the range of 2 to 40 inches of mercury absolute pressure. A total of 24 switches may be checked simultaneously on either opening or closing of the contacts. This test may be performed dynamically although the rate of pressure change is limited to approximately 200 ft. per sec. of altitude. Overall accuracy of the system is ± 1 mm of pressure.

Test results are obtained by photographing the face of mechan-

(Continued on Page 20)

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If you are a member of the IEE, and take an active part in its programs, your membership can cost you little or nothing. Here is a new program to help make your dollars go farther:

When you go to your local chapter meeting, you pay a door fee. This is enough to cover the cost of your dinner and leave a little extra for the chapter treasury. When you identify yourself as a member, the meeting secretary will issue you a receipt worth $1.00 when applied against your IEE dues. Non-members pay the same fee, get no receipt. Save your receipts, and when it comes time to pay your dues, send them in instead of dollars.

You will receive your receipt even if you do not belong to the chapter whose meeting you are attending. Thus, if you attend all of your own chapter meetings, and manage to visit a few neighbor chapters, you can easily gather eight or ten receipts in a year. This amounts to half your dues.

If you also attend the Annual Meeting, you save a substantial amount in the difference between member and non-member fees. This year the meeting committee is planning to issue similar receipts for this amount for those members who prefer to pay the full fee, and apply their receipts against their dues later.

There are some necessary restrictions. The receipts may not be redeemed for cash, and they are good for only one year after the date of issue. They may be used only by the person who received them; they are not transferable. One more thing: They cannot be replaced if they are lost.

Incidentally, as a member of the IEE, you can give your organization a big hand by sending in names of other people whom you think we should tell about the IEE, and not so incidentally, the complete program of the 1958 IEE meeting is presented on page 6 of this issue.

LOCAL CHAPTERS

(Continued from Page 17)

must respond to a broad frequency to record the distortion in a wave shape that would effect the indicated instantaneous acceleration, Bradley said.

The Oct. 16 meeting, Western Society of Engineers Bldgs., heard R. R. Bockemuehl of Physics Instrumentation Dept., Research Staff, General Motors, Corp., on "Instrumentation for Low Temperature Testing." On Nov. 20, Miquel Xavier, Technical Director, Inland Testing Labs, Cook Electric Co., addressed the Chapter on "A Technique for Evaluation of Electronic Components in the Radiation Environment."

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ENVIRONMENTAL PROBLEM

(Continued from Page 10)

weapon system). Yet, we're continually trying to make it satisfy both.

Organizational problems aren't solved on paper. However, they are most apt to be solved by first establishing broad policy and procedure relative to specific objectives. With this as a basis, logical division of responsibility commensurate with successively subordinate objectives can be made, and specifically delegated.

END

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LETTERS

(Continued from Page 19)

ical counters which indicate the height of a mercury column in millimeters and 1/10 millimeters. Each of the 24 counters is selectively illuminated when a particular test contact is operated. Four major components make up the tester: (1) a pressure sensing system, (2) a source of pressure and means for controlling its magnitude, (3) a recording device, and (4) various sources of power for operating the system.

The pressure sensing system is a barometer, the column height of which is dependent upon the range of pressures used for testing. The barometer is equipped with a scanning system which follows the mercury meniscus within certain rates. The scanner is gear-coupled to an output shaft which is coupled to an array of counters in the recorder. Pressure is obtained from a source of dry nitrogen and a vacuum pump. Nitrogen is used to prevent contamination of the switch contacts. Pressure control is obtained manually by use of a manostat or automatically with a Brown pressure controller.

The recorder contains 24 mechanical counters, all of which are ganged together and indicate the same manner—the elevation of the meniscus of the mercury column. The counters are driven directly from the output shaft on the barometer. Each counter has an associated xenon-filled photo-flash lamp which will illuminate a particular counter upon closure or opening of a particular contact being tested. The reading of each counter in millimeters and tenths Hg. pressure is recorded on polaroid film and, by shifting the camera, a total of 96 contact tests may be accomplished on a single piece of film.

The tester equipment, excepting the nitrogen source and barometer, is contained in two 66-inch relay racks.

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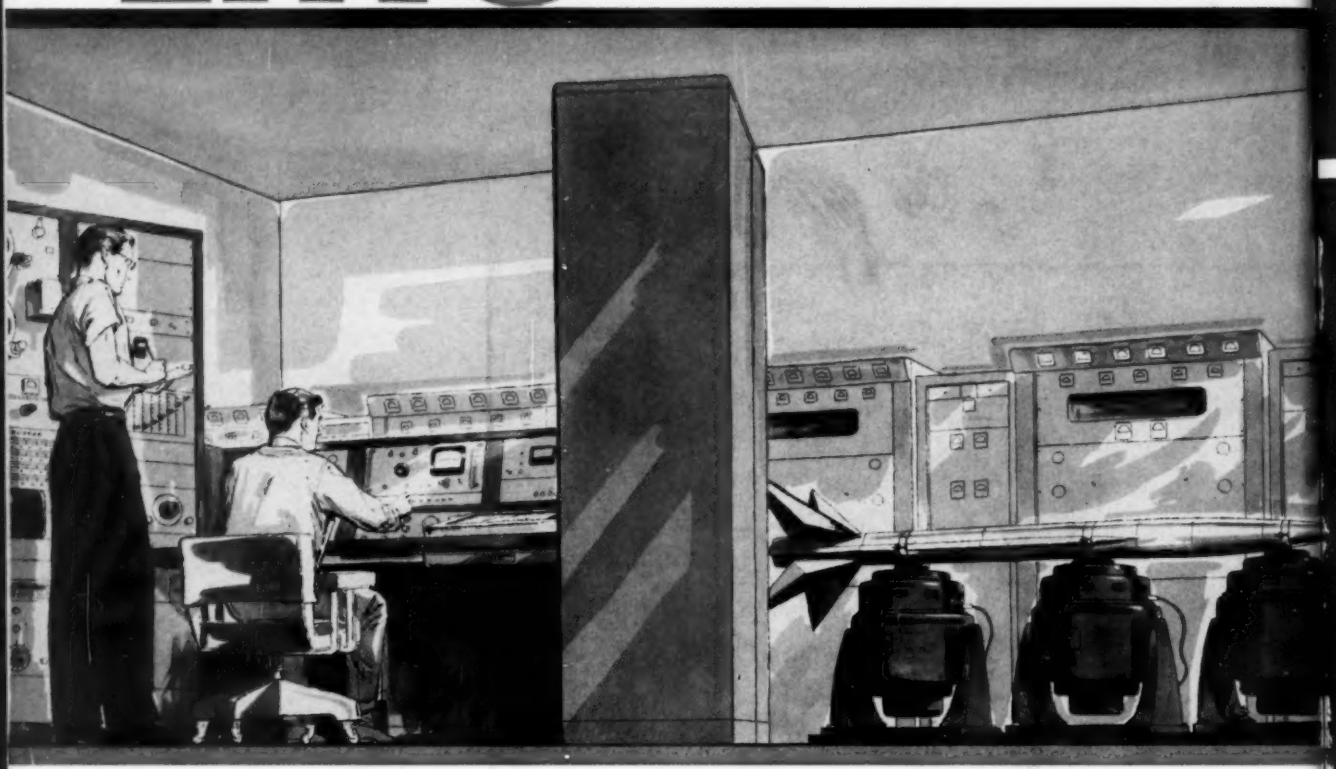

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PA-500-B	500 watts	800 watts	100	—	—	—
PP-1/2-B	1,000 watts	2,000 watts	200	—	—	—
PP-3.5/4-A	3,500 watts	4,000 watts	800	500	1,500	—
PP-7/8-B	7,000 watts	10,000 watts	1,200	840	2,520	AP-10-A
PP-20/20-C	22,000 watts	22,000 watts	3,500	2,500	7,500	AP-30-A
PP-40/40-B	44,000 watts	44,000 watts	5,000	3,500	10,500	AP-40-A
PP-68/80-A*	60,000 watts	80,000 watts	7,000*	5,000*	15,000*	AP-60-A
PP-68/80-A*	60,000 watts	80,000 watts	17,500*	10,700*	32,000*	AP-60-A
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